US-GE Coalition C2 R&D Technology Program

Simulation & C2 Information Systems Connectivity Experiments (SINCE)

- Presented to 8th International C2 Research and Technology Symposium
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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2003		**00-00-2003 to 00-00-2003**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Simulation & C2 Information Systems Connectivity Experiments (SINCE)	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Army Communications-Electronic Command (CECOM),Research Development and Engineering Center (RDEC),Fort Monmouth,NJ,07703**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**		**43**	

Introduction

- This presentation describes the goals and implementation approach of the US national program supporting Transformation efforts for multi-national command and control (via a bilateral approach (US and Germany).
- In the conduct of the SINCE program, both the US and Germany will be tying together appropriate Command and Control Information Systems (C2IS) and Modeling and Simulation (M&S) systems as necessary to support these experimentation activities
- These experiments will focus on the conduct of collaborative Mission Planning and Execution Management activities as needed to support coalition force operations
  - ⇨ Improving information exchange interoperability and situation understanding
  - ⇨ Streamlining/improving decision making process for commanders
  - ⇨ Demonstrating the use of M&S to support the Decision Making Process
  - ⇨ Combined military user and development community participation
- Each nation has and will implement its own unique national approach for supporting and participating in SINCE.
- The US and Germany are jointly working to define and implement common information exchange mechanisms needed to support SINCE

Program Objectives

The goals of the US SINCE program are to:

- Provide US Army Objective Force and Future Combat System (FCS) Commanders operating in coalition operations with improved means for
  - ⇨ visualizing the coalition battlespace
  - ⇨ planning, executing and managing coalition operations,
  - ⇨ performing real-time collaboration and information exchange with coalition partners
- Demonstrate new, affordable, and enhanced means for achieving interoperability between evolving Objective Force/FCS C2IS and those of our coalition partners
- Integrate and use M&S technologies to facilitate/support Combined Operations

SINCE Implementation Concepts

Thrust Areas:

- Brigade and Battalion Level CJTF Operations in an future 2010 Objective Force/Future Combat System (FCS) environment
- Shared Situational Understanding is critical
  - ⇨Understanding via one's own C2 system
- Execution Monitoring using National C2 systems
  - ⇨Supports national, doctrinal approaches to operations
  - ⇨Uses embedded, synthetic environments to drive C2 interoperability
- Evaluation of new C2 System interoperability concepts
  - ⇨Redefine Combined Operations C2 paradigm (e.g. STANAG)
  - ⇨Ultimately drives the technical approach to international C2 systems interoperability.

SINCE Experimentation Program Schedule

1a. Establish technical feasibility and ensure the connectivity and interoperability of all C2/ M&S systems

- Experiment 1a (Technical Connectivity)
- Done at Greding
- Technical in nature/ Operational oversight
- TWG has lead

2. Determine the next level technical feasibility and ensure the updated connectivity and interoperability of all C2/ M&S systems

Nov 03 Apr 04 Jun 05 Mar 06

Quarter	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Experiment 1a														
Experiment 1b														
Experiment 2														
Experiment 3														

- 2nd Experiment
- Done a UAMBL & Greding
- Operational in nature (focus at Bn Level)
- OWG/UAMBL has lead

- 3rd Experiment
- Done a UMAMBL, BCBL and /or JFCOM
- Operational in nature (fucus as CJTF level)
- OWG/UAMBL has lead

1b. Scenario that is constrained by the IER within the C2 systems and by the interoperability constraints of the simulation systems

- Experiment 1b (Operational Checkout)
- Done at Ft. Monmouth and Greding
- Operational nature w/ Technical oversight
- OWG has lead (potential use of CFBL net)

3. Complex military scenario (across the spectrum of war – support ops to mid intensity) unconstrained by earlier limitations of C2 systems and interoperability

SINCE Experiment 1a: Schedule

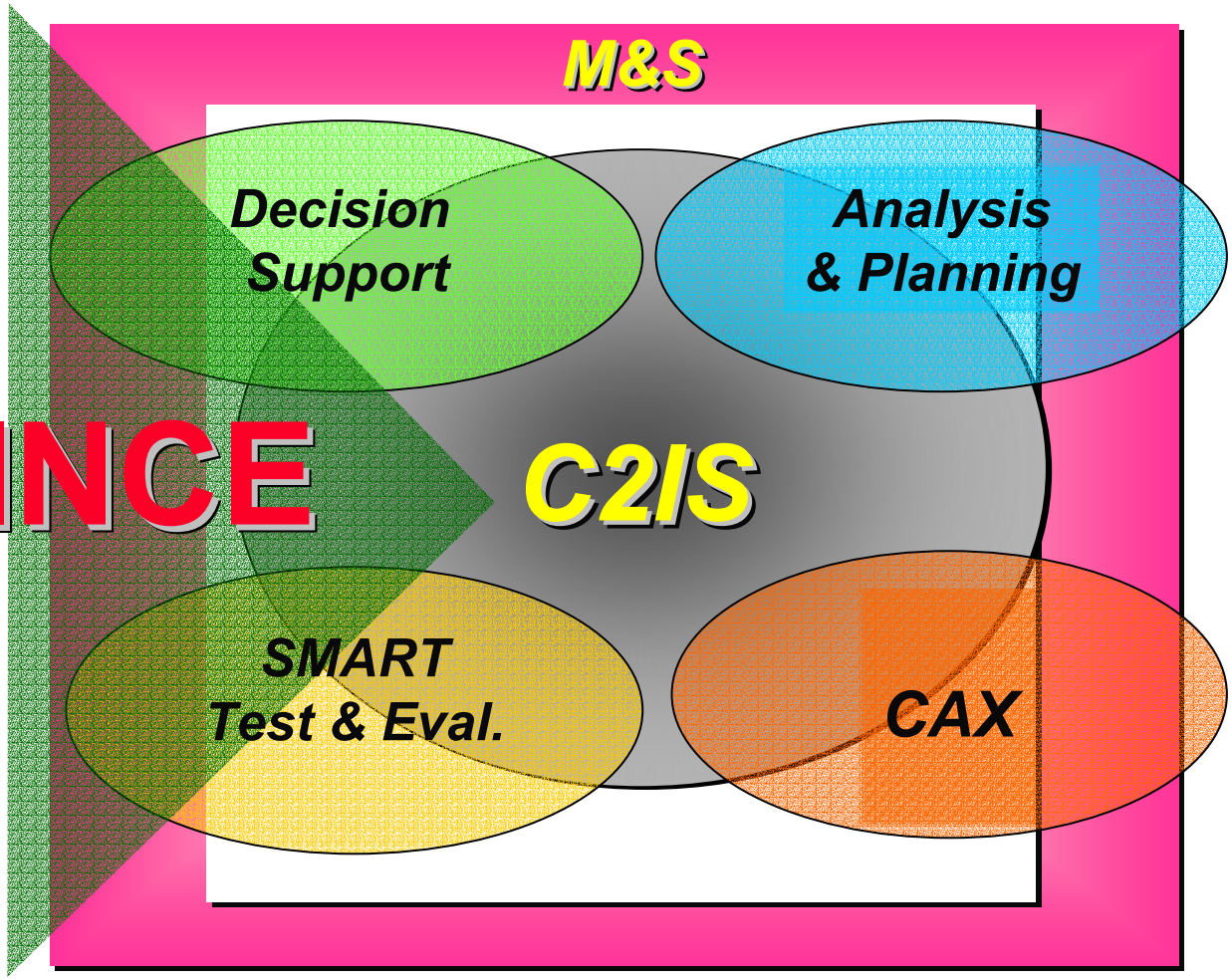
			SINCE Testing						SINCE Experiment				
			Connectivity			Federation			Collaboration			Interoperability.	
			Day 1 Mon.	Day 2 Tue.	Day 3 Wed.	Day 4 Thu.	Day 5 Fri.	Day 6-7 Weekend.	Day 8 Mon.	Day 9 Tue.	Day 10 Wed.	Day 11 Tue.	Day 12 Fri.
Experim't Control (M&S)		SINCE Proxy OTB	Stand Alone Installation And Configuration	Uni-National Systems Network Configuration	Multi-National Systems Network Configuration	Update all data Bases Database tests w/ technicians	Crawl-through Scripted Walk-through Scripted						TWG AAR
						Technician Training	Run-through Script Ad hoc run				Plan for Ad hoc Iteration(s)		OWG AAR Experiment 1b Update
Experiment	Planning	CAPES WebC2B				Update all data bases Database tests w/ technicians	Crawl-through Scripted Walk-through Scripted	OPEN	Scripted Mission Run Iteration 1	Update System Configurations	Scripted Mission Run Iteration 4	Ad hoc Mission Run Iteration 1	TWG AAR
						Operator & technician Training	Run-through Scripted Ad hoc run		Scripted Mission Run Iteration 2	Scripted Mission Run Iteration 3	Plan for Ad hoc Iteration	Ad hoc Mission Run Iteration 2	OWG AAR Experiment 1b Update
	Execution	C2COP WebC2B				Update all data Bases Database tests w/ technicians	Crawl-through Scripted Walk-through Scripted		Scripted Mission Run Iteration 1	Internal AAR With BN level Operators	Scripted Mission Run Iteration 4	Ad hoc Mission Run Iteration 1	TWG AAR
						Operator & technician Training	Run-through Scripted Ad hoc run		Scripted Mission Run Iteration 2	Scripted Mission Run Iteration 3	Internal AAR With BN level Operators	Ad hoc Mission Run Iteration 2	OWG AAR Experiment 1b Update
						TRAINING			Execute scripted Missions/Tasks			Execute Ad hoc Tasks	

Battalion | Company

CECOM Bottom Line: THE WARFIGHTER

Bridging the Technical & Operational Problems

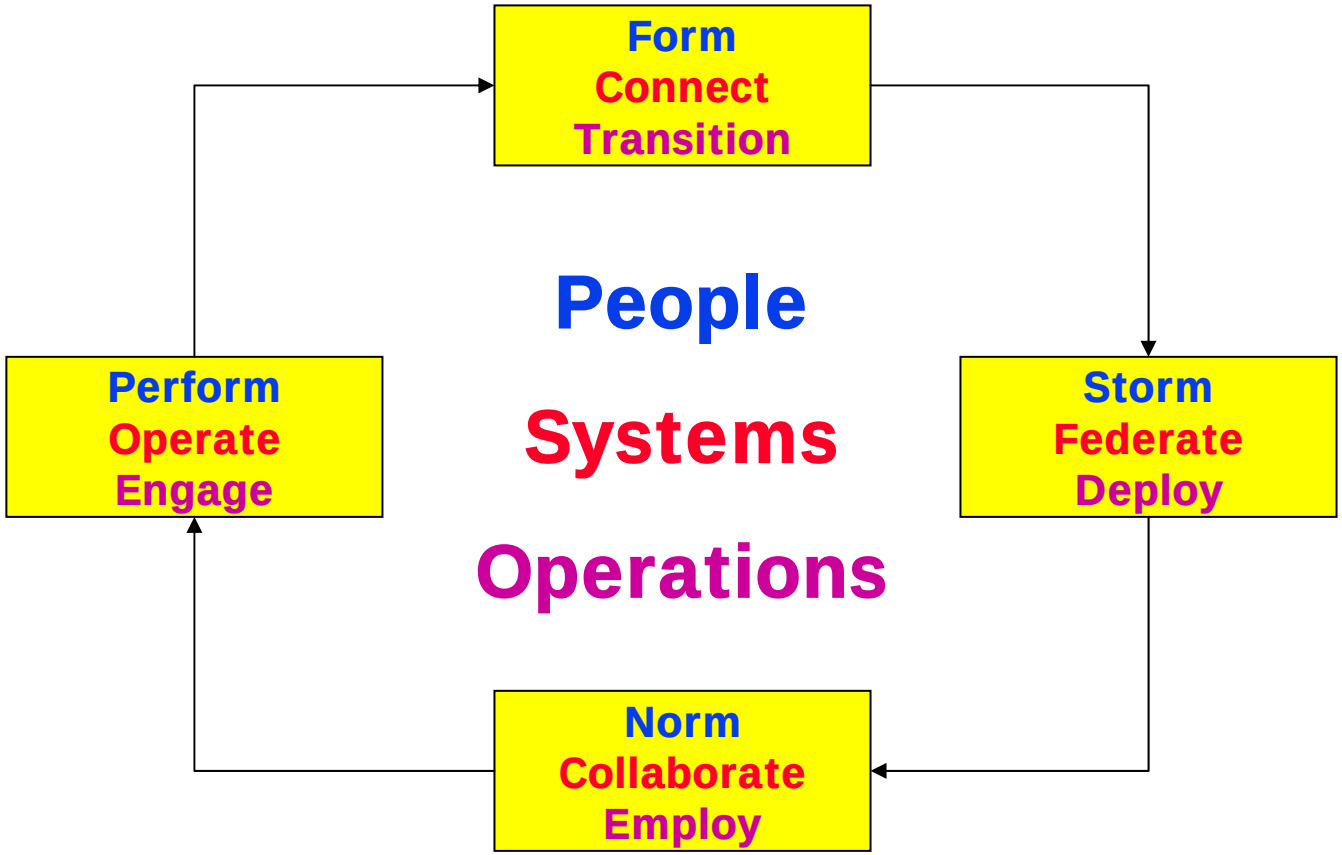
Simulation Systems Meet C2IS



Collaborative Planning Decisions

CECOM Bottom Line: THE WARFIGHTER

Phases of Team, System, and Mission Execution Developments



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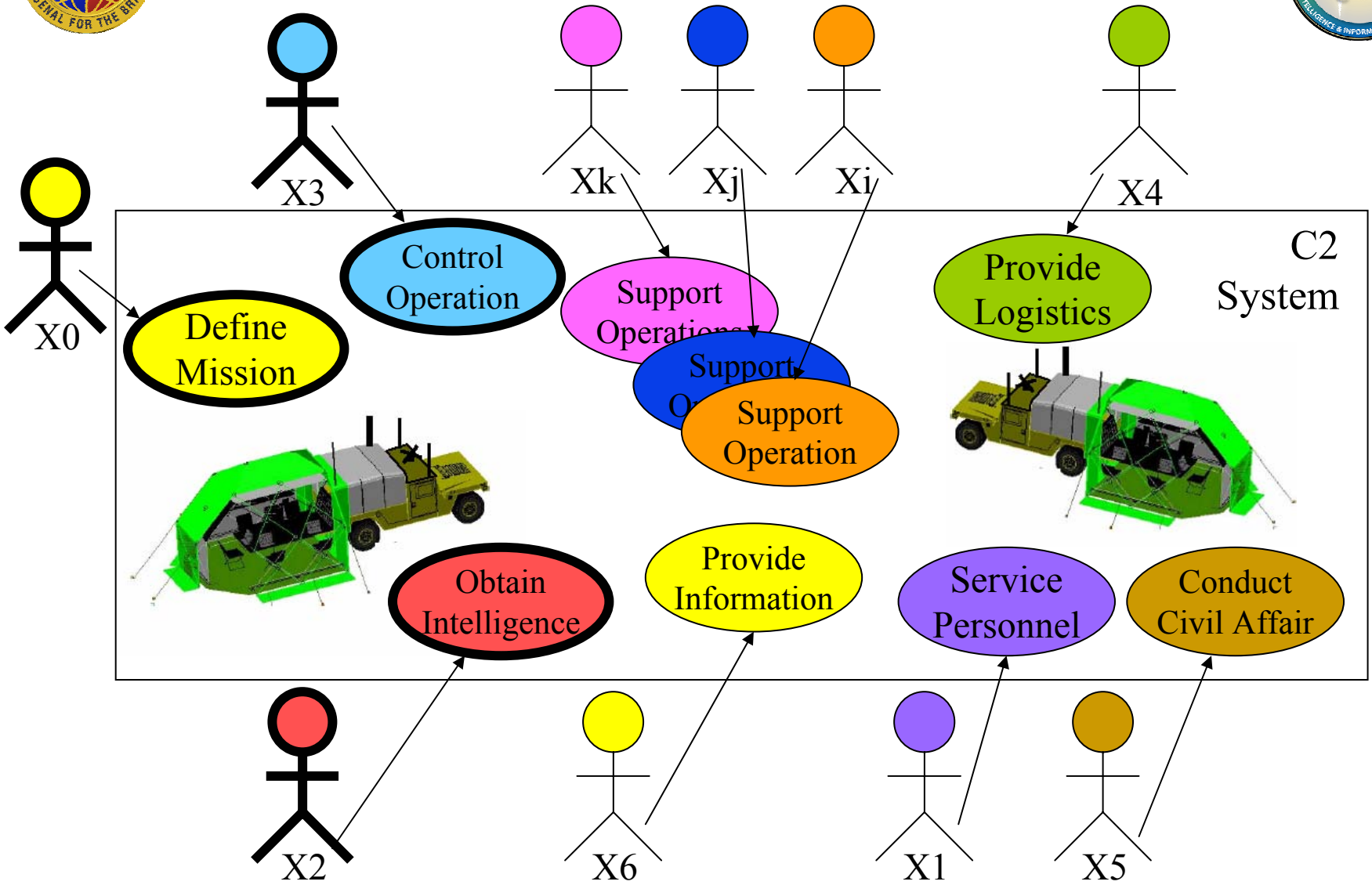
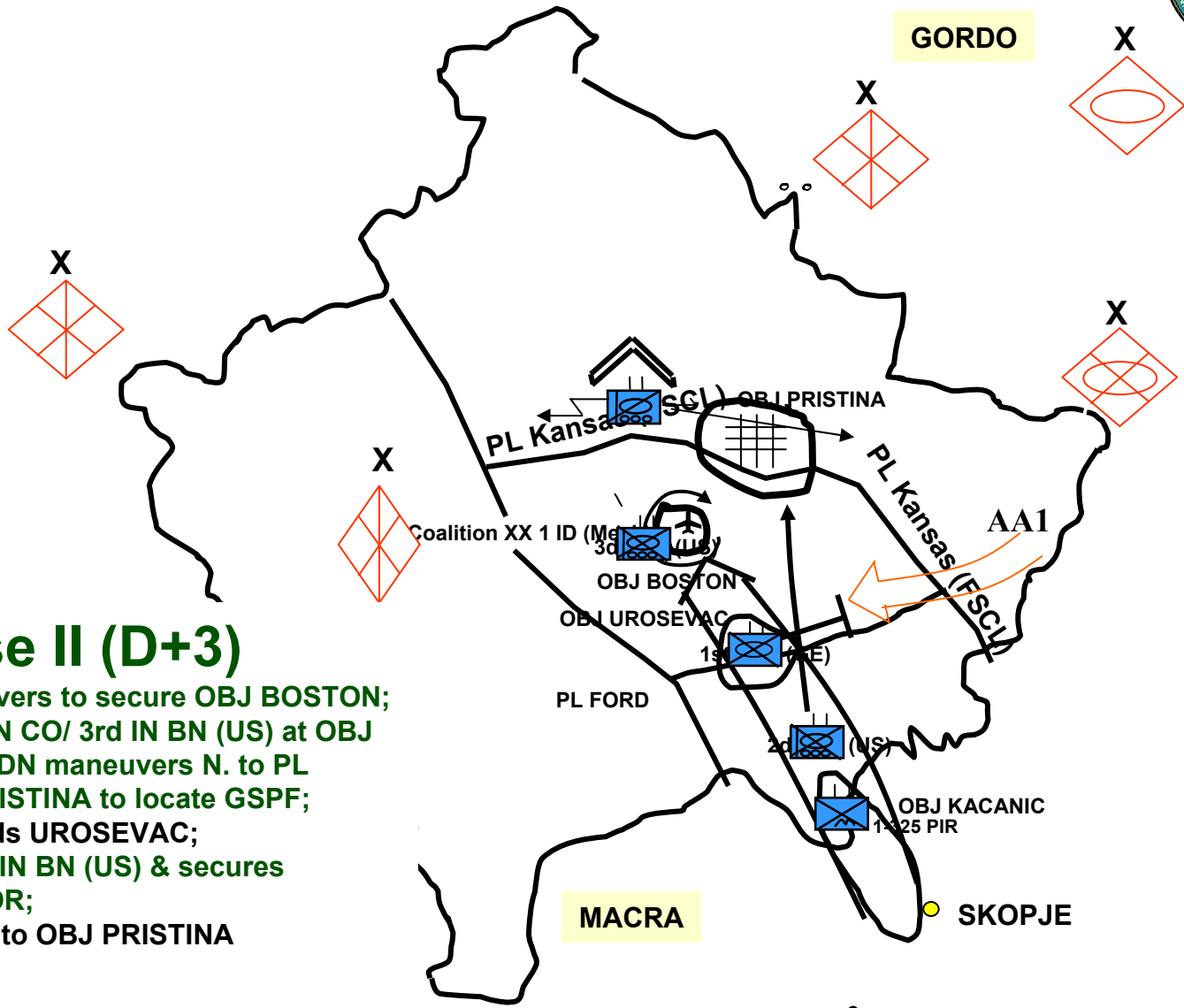
Experiment 1 - Operational Use Cases



Experiment 1 - Operational Scenario



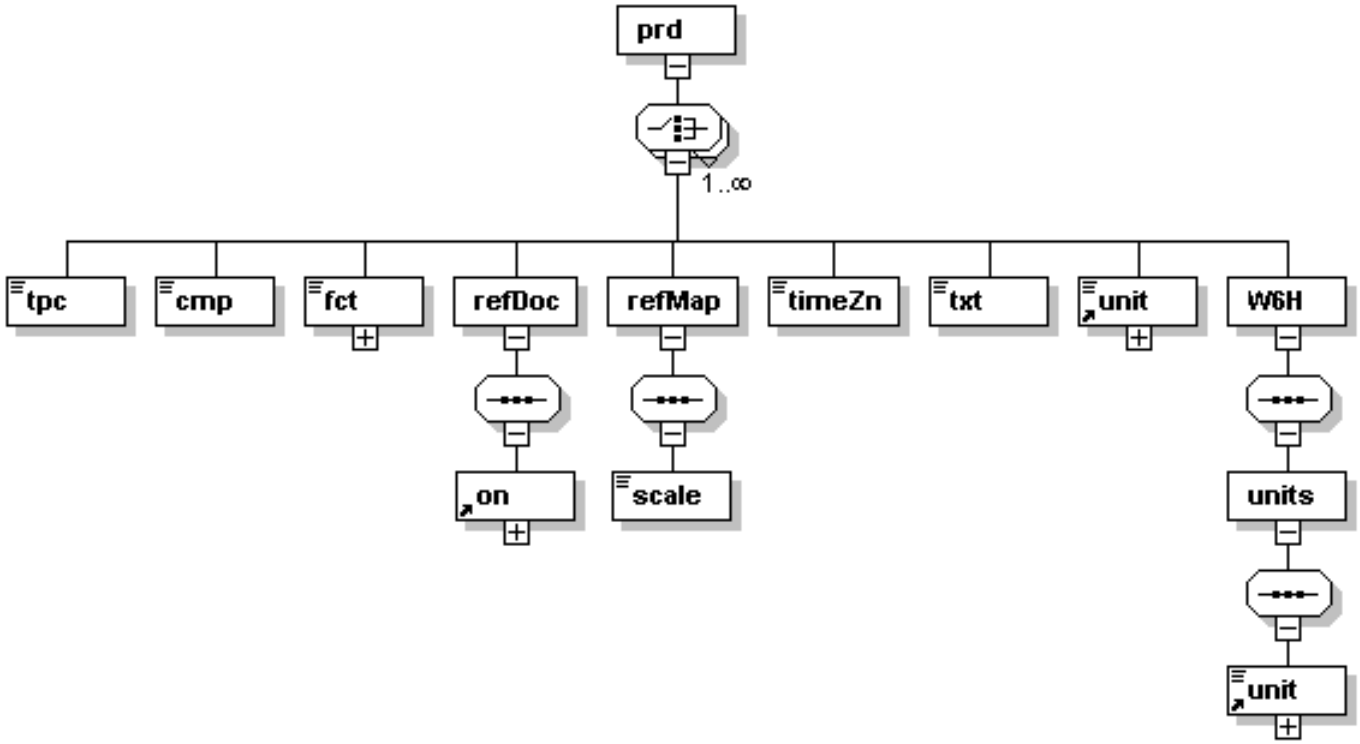
Phase II (D+3)

3d IN BN (US) maneuvers to secure OBJ BOSTON;
Upon closure of 1st IN CO/ 3rd IN BN (US) at OBJ BOSTON, RSTA SQDN maneuvers N. to PL Kansas and into PRISTINA to locate GSPF;
1st IN BN (GE) defends UROSEVAC;
1/325 PIR relieves 2d IN BN (US) & secures KACANIC CORRIDOR;
2d IN BN (US) moves to OBJ PRISTINA

C2 Product: - OPORD, Messages

- **Situation**
  - The Enemy Forces
    - Who are they? What kind of unit is it? What kind of Equipment do they have?
    - Where are they? How strong are they? Where are they effective?
    - How capable are they? What are they likely to do?
  - The Friendly Forces
    - What is our higher echelon mission and Concept of Operation? What is the mission of adjacent units?
- **Mission**
  - A clear concise, statement of what the unit is to do to include who,where, when, and why of the operation.
- **Execution**
  - What is the Concept of Operation? How to maneuver, how to fire, how to deal with obstacles? In Offense: what unit formations, movement techniques, routes of advance? On Defense: what battle positions to establish, weapon orientation, engagement plan, +more.
- **Service Support**
  - Where is refueling, How? Where is the collection point of damaged vehicles?
- **Command and Signal**
  - How communications will be maintained?
  - What is the command succession?

Experiment 1 – C2 Products



Generated with XMLSpy Schema Editor www.xmlspy.com

Experiment 1 – System States and Use Cases

- **Interconnection State**:
  - Interconnect Federate
- **Federation State**:
  - Enable Federate, Initialize Federate
- **Collaboration State**:
  - Collaborate with Coalition (to Plan Operation)
- **Interoperation State**:
  - Stimulate Federate,
  - Interoperate with Coalition (to Monitor Execution)

Typical OPORD Text Parsed by W6H Rules

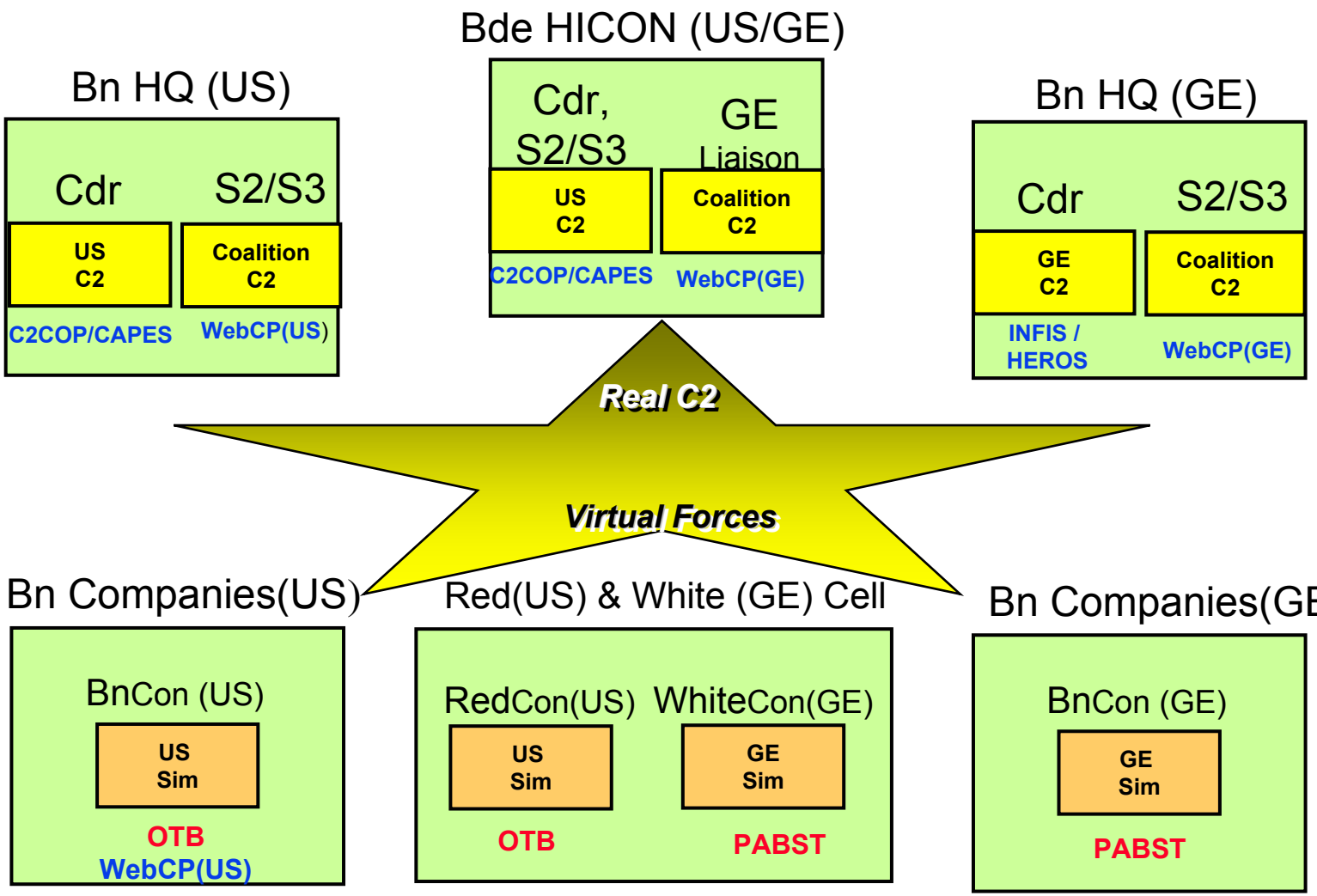
On order IBCT deploys to MACRAN REPUBLIC and moves immediately to Kazar to secure the KACANIC CORRIDOR, PRISTINA Airfield, and PRISTINA, and to establish a US presence throughout the zone. IBCT cooperates with KAF to defeat GSPF elements in zone and deters a Gordian attack on Kazar. If deterrence fails, IBCT defends in order to defeat GAF attack and to restore Kazarian territorial integrity.

Why	Who	Where	When	How	What	Which

OPORD Text represented in XML

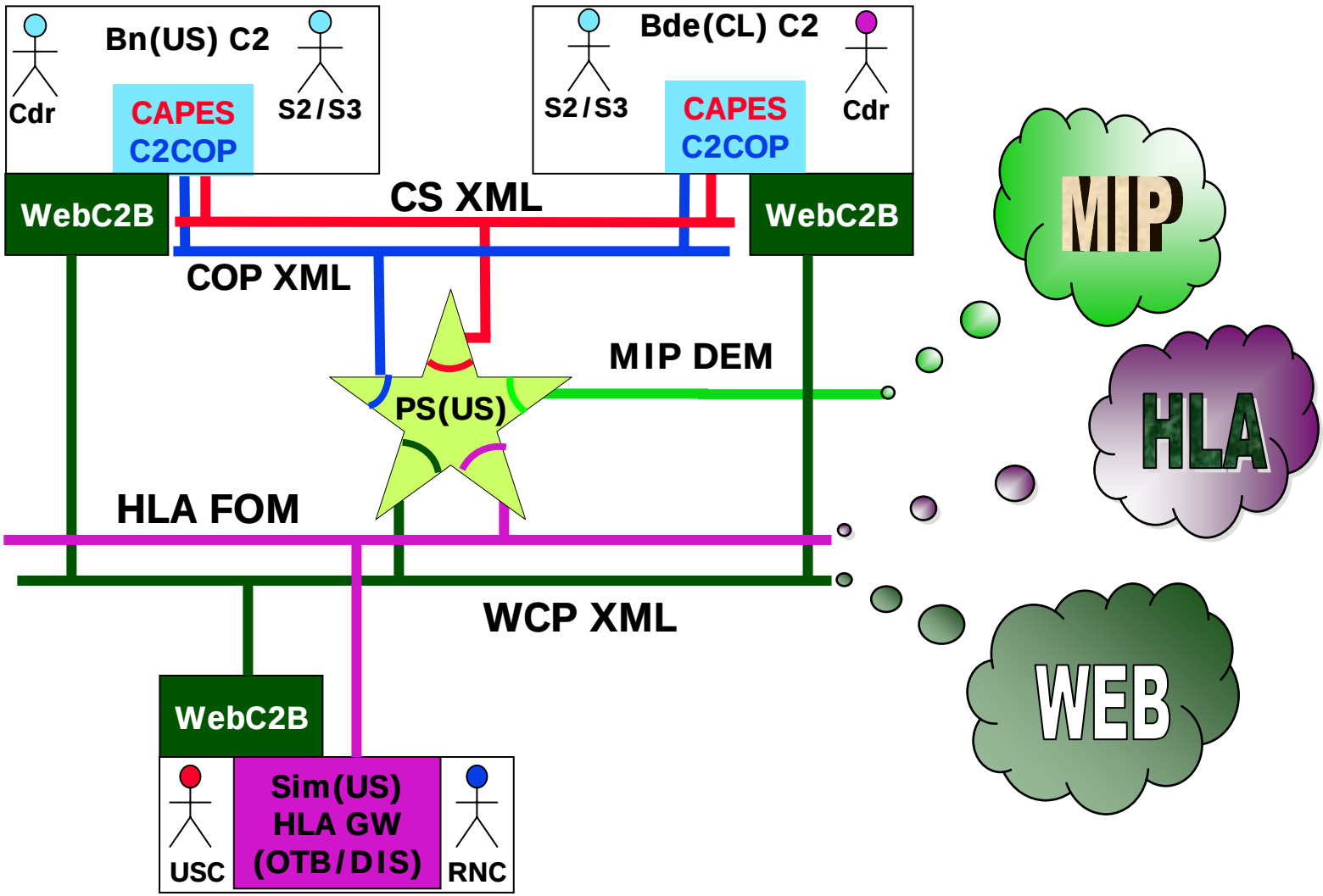
```
<?xml version="1.0" encoding="UTF-8"?>
<grp type="Situation/Friendly Forces" fnc="Mission">
<on type="order"><unit id="1st" role="IBCT" size="Bde" aff="Coalition"/><do type="mission">deploy</do>
<at type="state" name="Macran Republic"/><do type="mission">move</do><by type="rate">immediately</by>
<at type="region" name="Kazar"/><to>secure</to><at type="Corridor" name="Kacanic"/><to>secure</to>
<at type="airfield" name="Pristina"/><to>secure</to><at type="region" name="Pristina"/><to>establish</to>
<units aff="US"/><at type="zone" aff="Kazar"/><To>cooperate</To><Link><unit id=" KAF"/><To>defeat </To>
<unit id="GSPF" size="elements"/><at type="zone" name="Pristina"/><To>deter</To><Link><unit aff="Gordo"/>
<do> attack</do><unit aff="Kazar"/></Link><if><Link><unit aff="Gordo"/><do> attack</do><unit aff="Kazar"/>
</Link><then><do>defend</do><To>defeat</To><unit id="GAF"/><To> restore</To><unit aff="Kazarian">
<Status>territorial integrity </Status></unit></then></if></Link></on>
</grp>
```

Experiment 1 - Operational Configuration



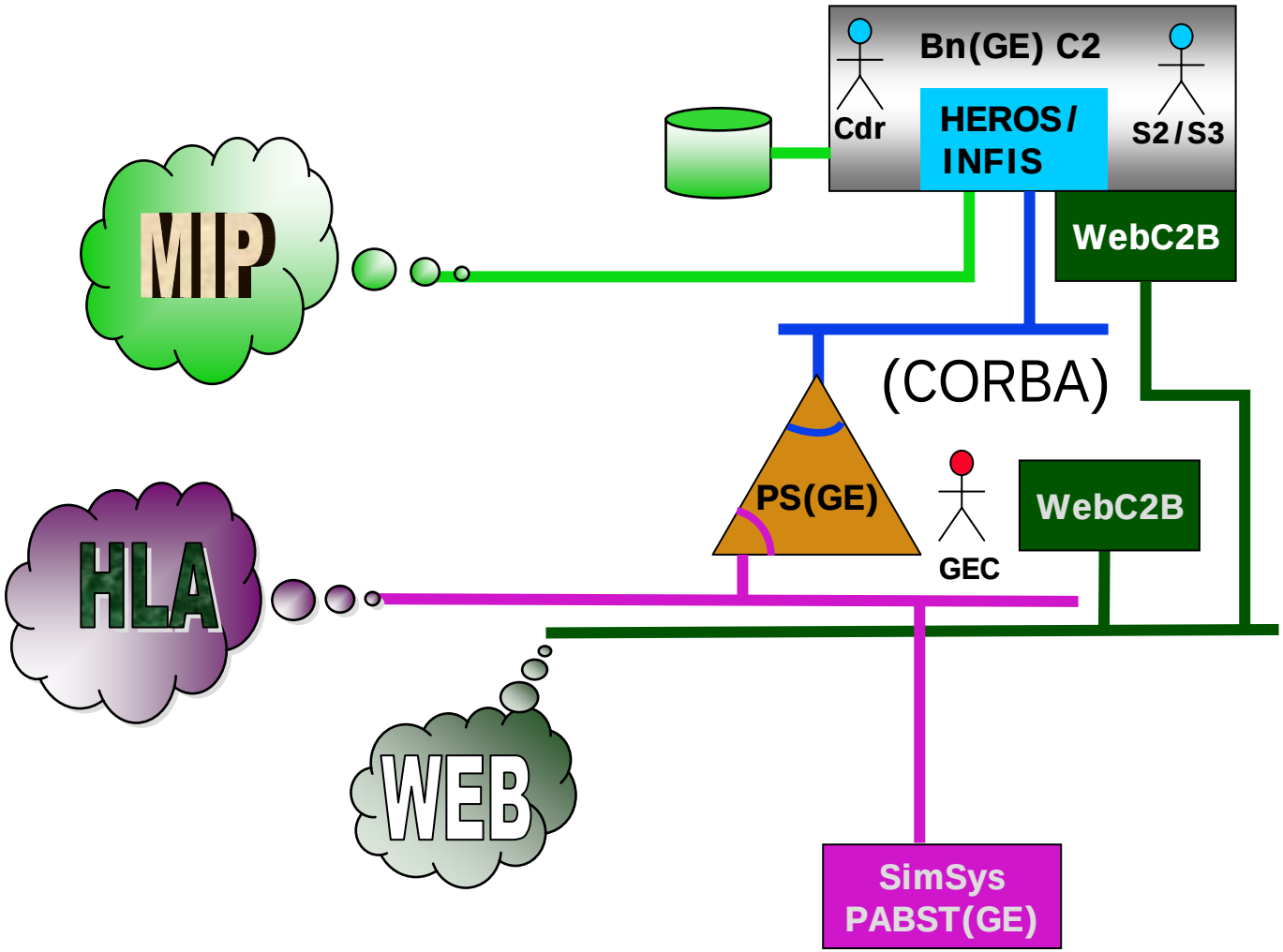
CECOM Bottom Line: THE WARFIGHTER

SINCE Experiment 1: US Environment



CECOM Bottom Line: THE WARFIGHTER

SINCE Experiment 1: GE Environment



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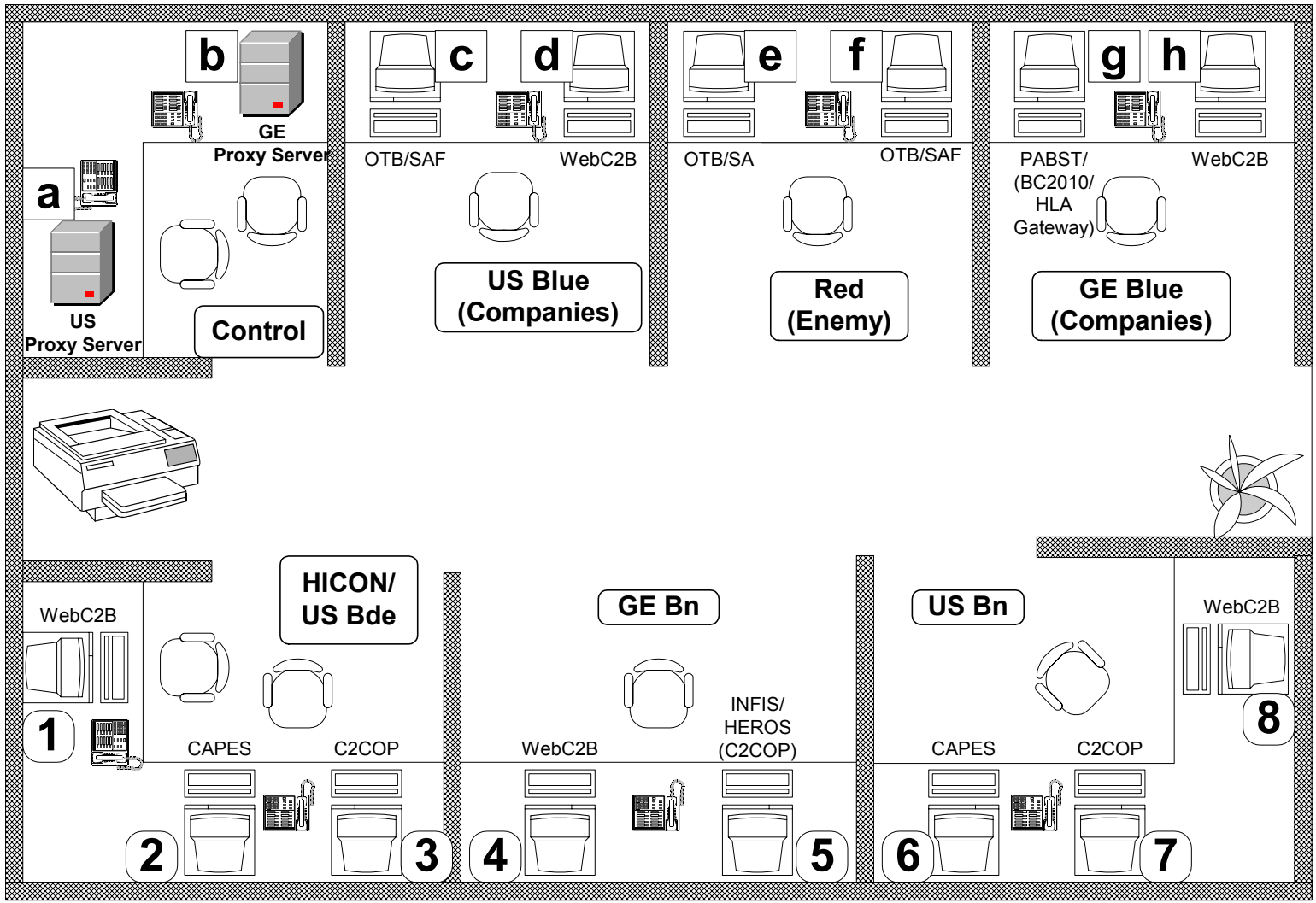
Experiment 1: Initial Configuration



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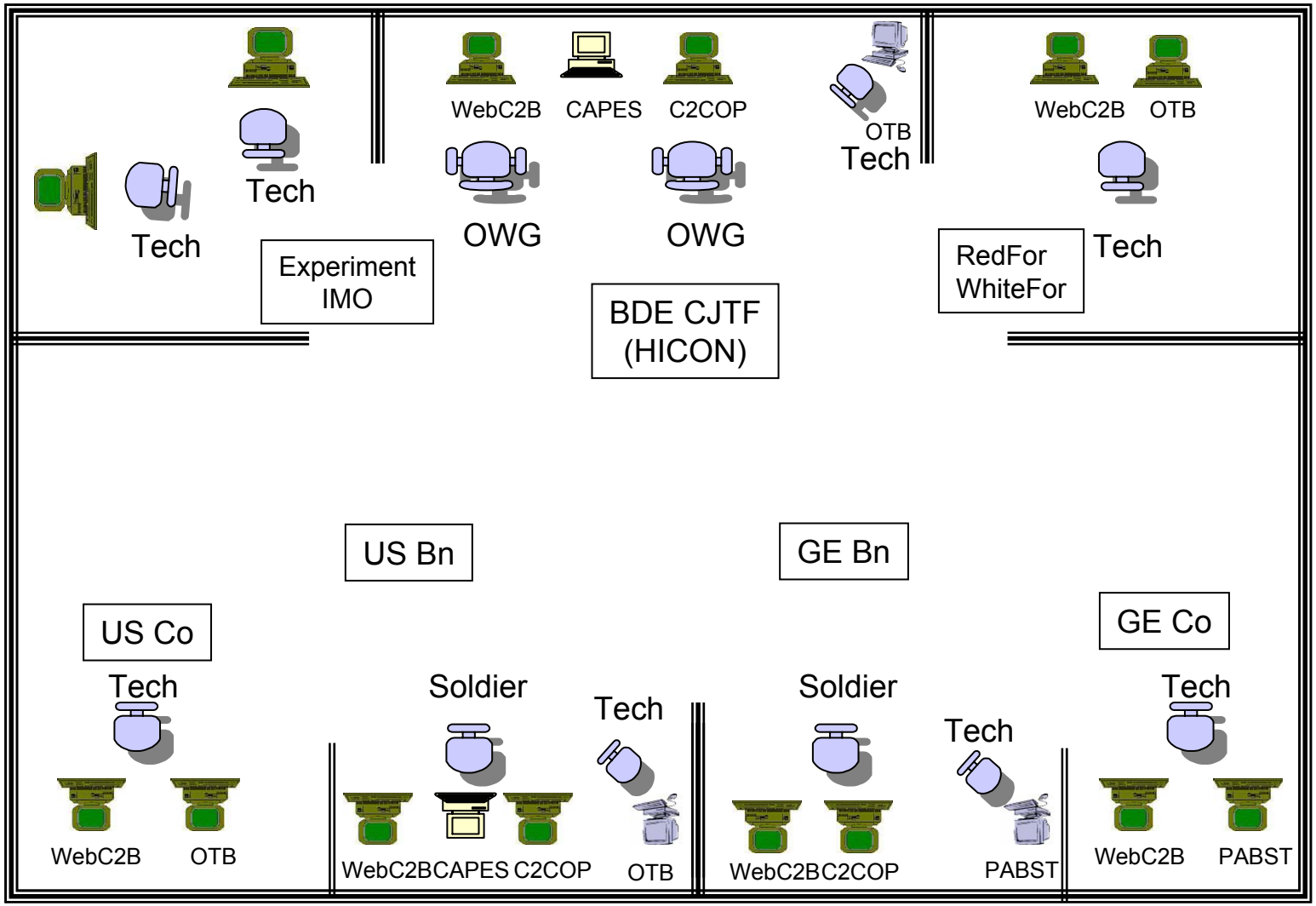
Experiment 1a: Functional Configuration



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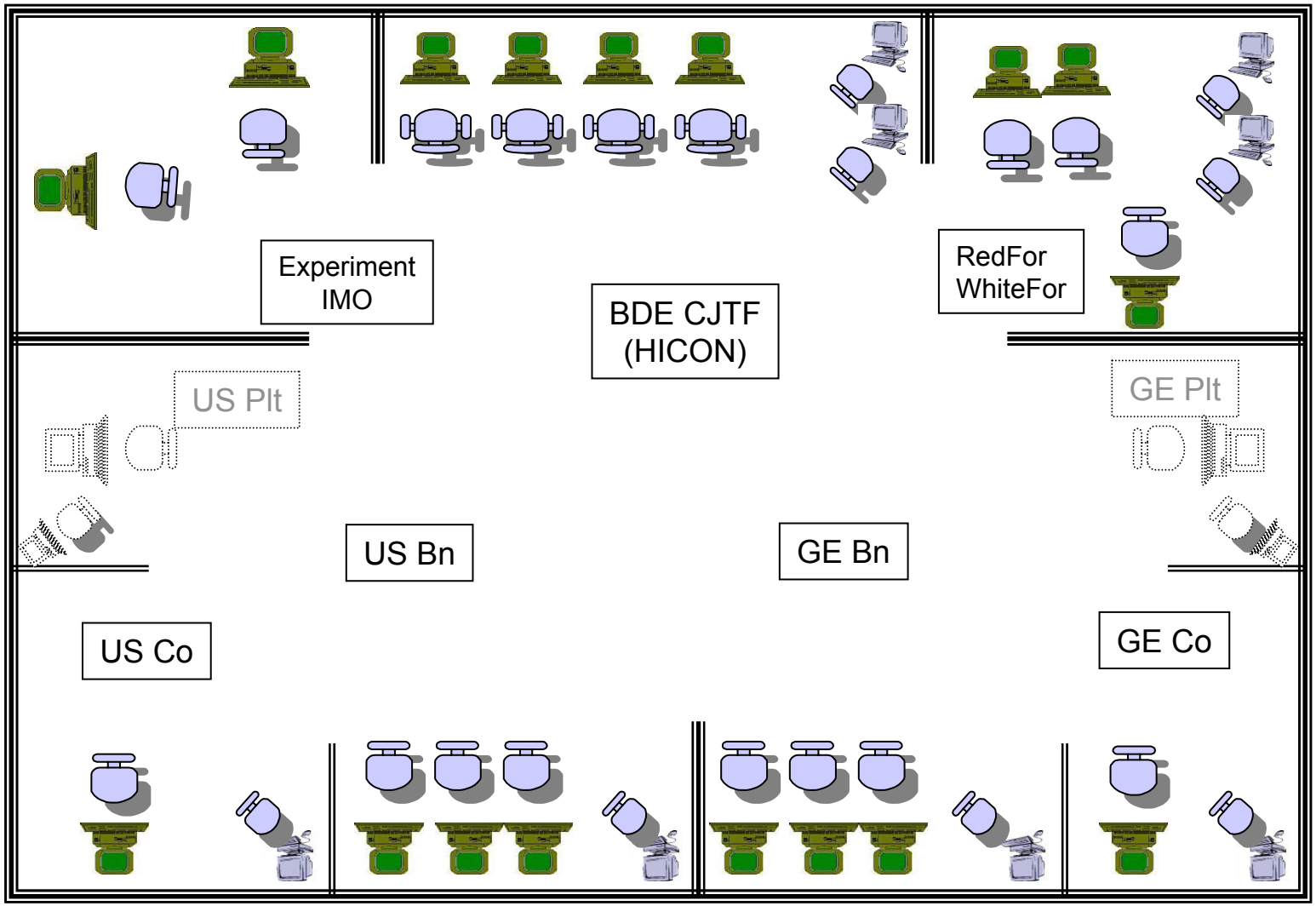
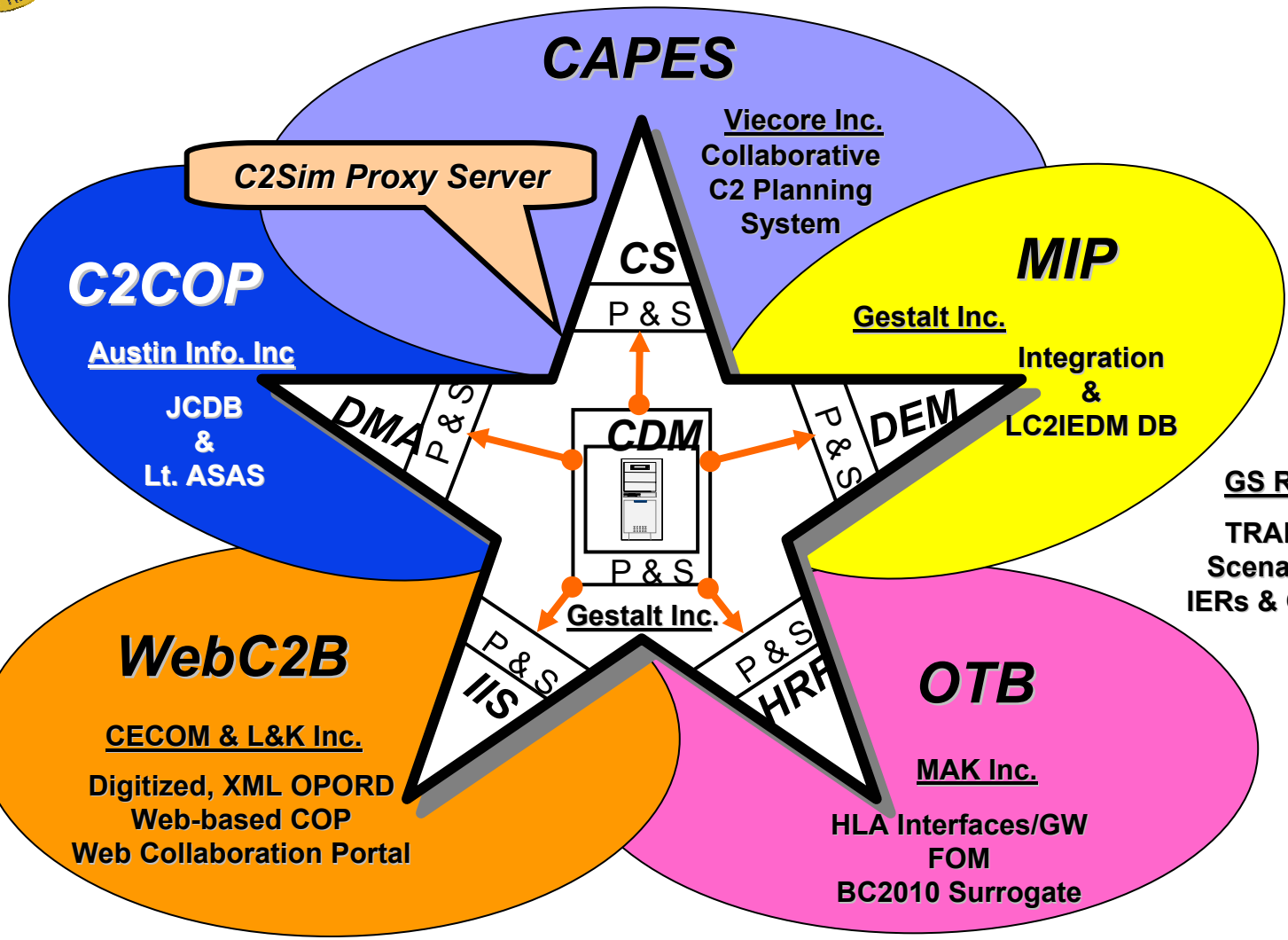
Experiment 1b: Operational Configuration



SINCE Information Exchange Mechanisms

- **Common Relevant Operating Picture (CROP) information exchanges between coalition C2 Systems:**
  - Exchanged via MIP LC2IEDM AdatP3 Messages or
  - **LC2IEDM database to database replication** mechanisms
- **Modeling and Simulation (M&S) Systems state information exchanges:**
  - Defined in the structure of HLA Federate Object Model
  - Exchanged **HLA RTI** Mechanisms
- **Real-time Tactical Planning Information exchanged between coalition force military planners and operations managers:**
  - Defined as **XML based text and graphics** constructs
  - Exchanged primarily via Web-based Collaboration Portal
  - Mapped into extended LC2IEDM/JDM database (planned)

SINCE C2Sim Proxy Server



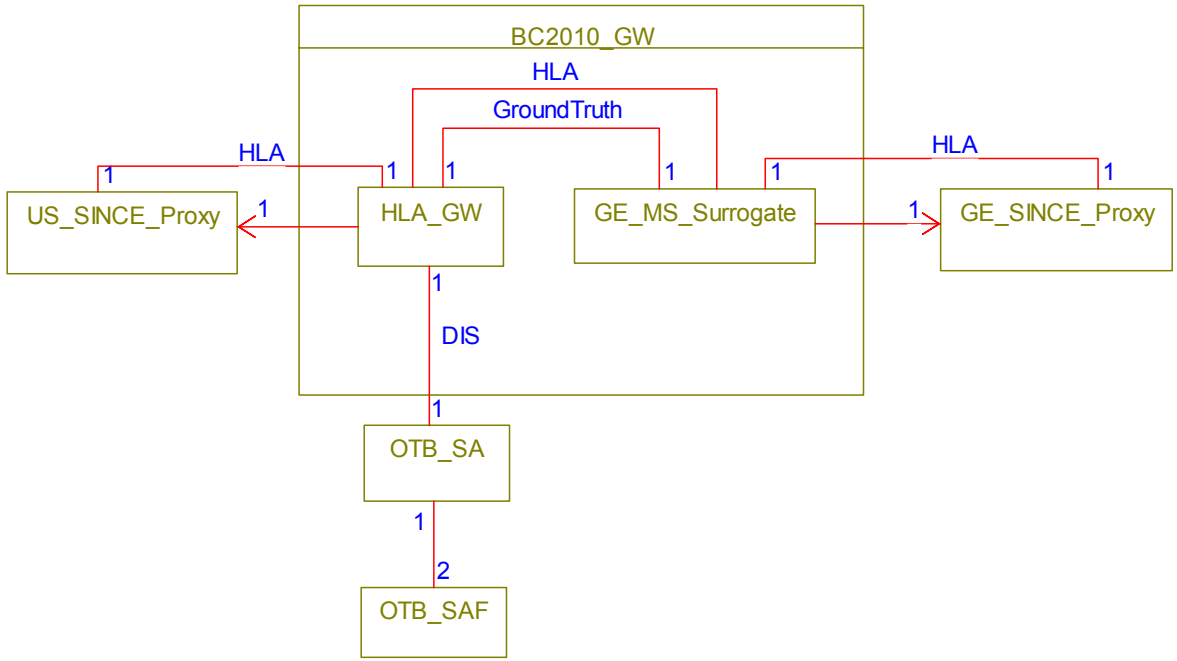
GS Research LLC

TRADOC Support
Scenarios, OPORDS
IERs & C2 Func. Rqmts

Object Model Diagrams: **BC2010**

Source Document:
SINCE - Info Flow 3.1a.ppt
Page 2

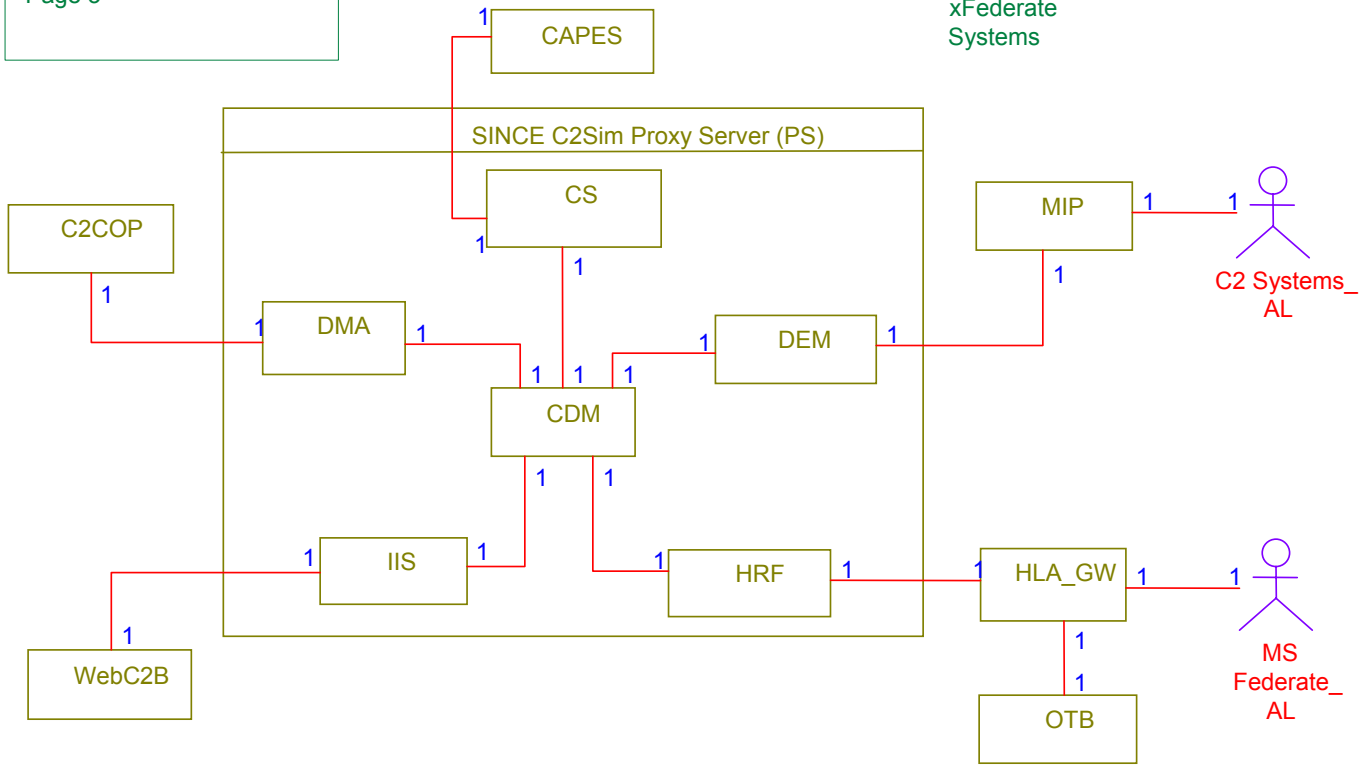
BC2010/GW plays the roles of an Allied M&S surrogate and an OTB to HLA Gateway



Object Model Diagrams: **SINCE C2Sim PS**

Source Document:
SINCE - Info Flow 3.1a.ppt
Page 3

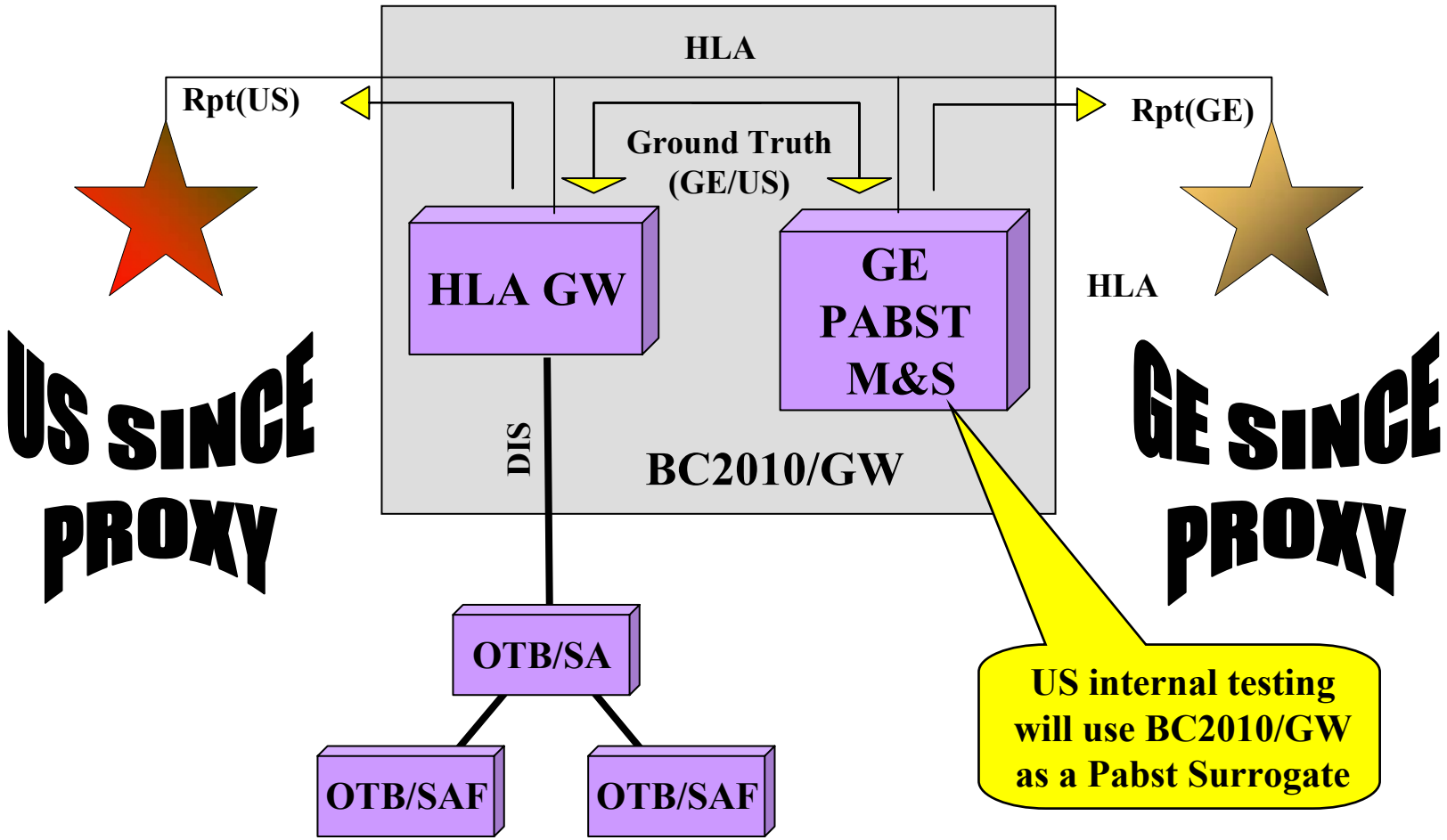
US
xFederate
Systems



C2Sim Proxy Server Acronyms

- CAPES - Combined Arms Planning and Execution System
- C2COP - C2 Common Operational Picture
- CDM - Coalition Domain Manager
- CS - Collaboration Server
- DEM - Data Exchange Mechanism
- DMA - Data Model Adapter
- HRF - High Level Architecture Real-time Infrastructure Reference Federation Object Model
- MIP - Multilateral Interoperability Program
- OTB - OneSAF Test Bed
- P&S - Publish and Subscribe Mechanism
- WebC2B - Web C2 Browser, Web Portal

SINCE Interface of US and GE M&S

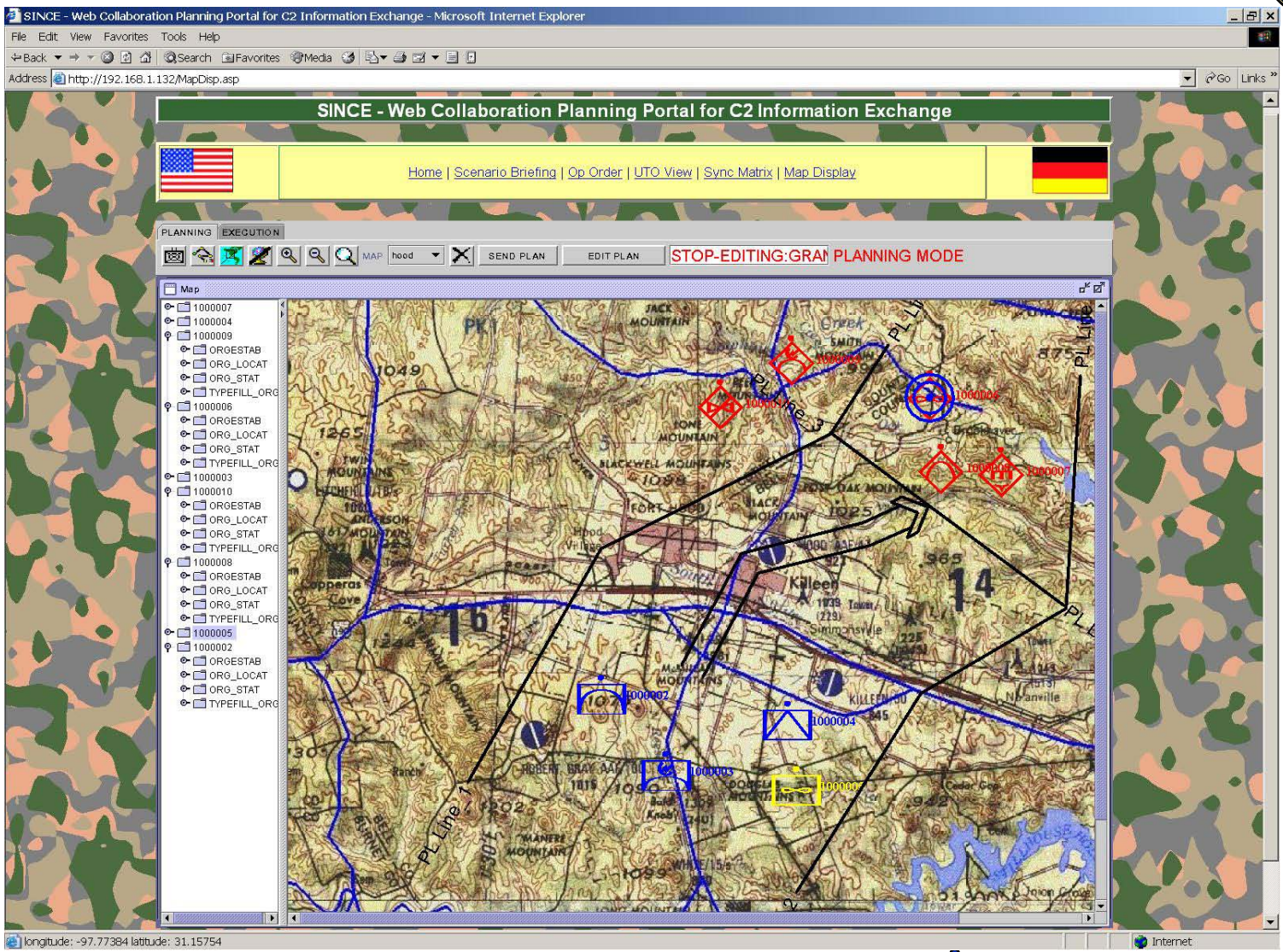


Web-based Collaboration Portal Exchanges

Supports real-time situation visualization and planning concept information exchanges by

- Enabling coalition force planners to jointly view the evolving operational picture
- Supporting the exchange of visual battlefield and operation graphics information during a planning session
- Supporting the generation and display of coalition force Operational Orders, Frago's and Task Force Synchronization Matrix information via common XML-based constructs
- Implementing a common agreed upon set of terms, tactical phrases and battle management language/concepts for exchange of textual planning information that assure consistent execution of coalition operations.

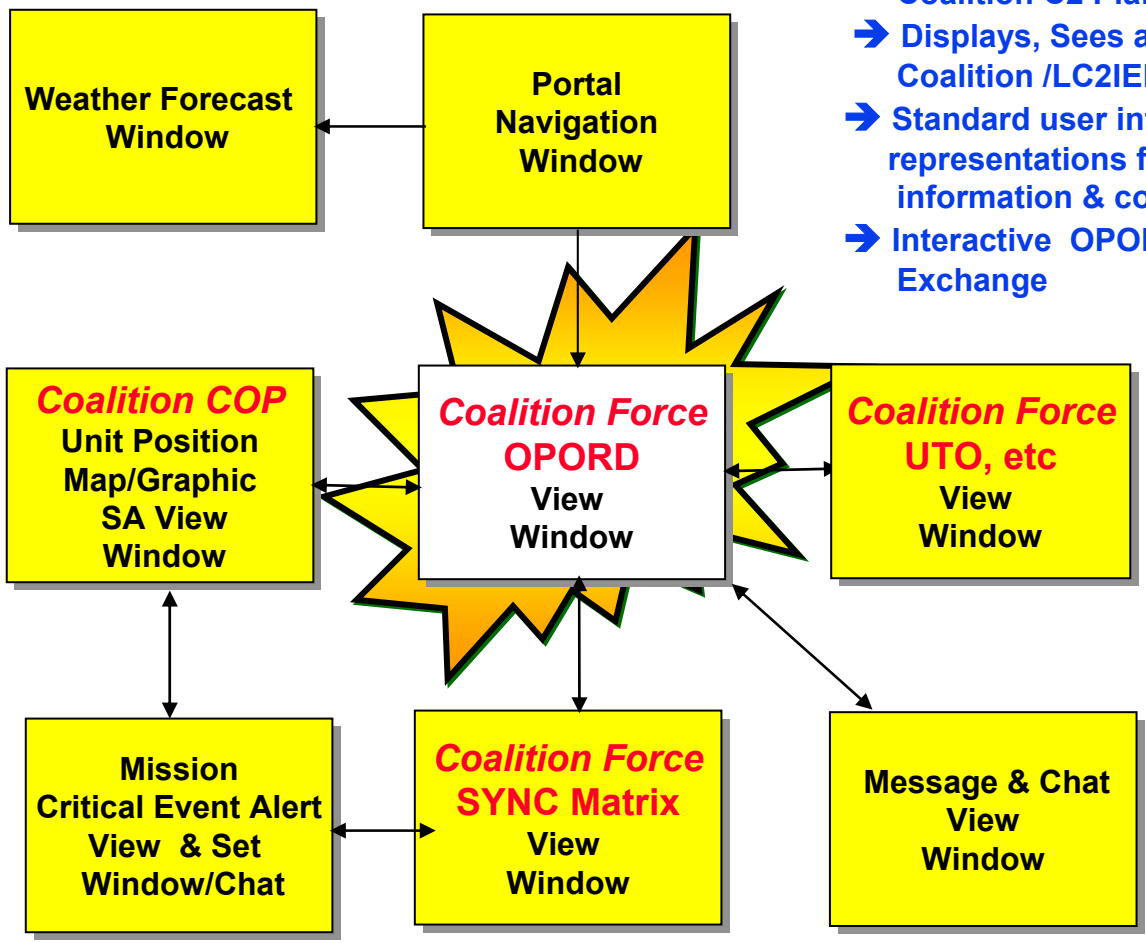
Web-Based Collaboration Portal (WCP)
View of the Coalition CROP



CECOM Bottom Line: THE WARFIGHTER

The Web-based Collaboration Portal (WCP)

- Gateway between National & Coalition C2 Planning Systems
- Displays, Sees and Operates on only Coalition /LC2IEDM Information
- Standard user interfaces & information representations for exchange of planning information & concepts (BML, Graphics,etc)
- Interactive OPORD building and Info Exchange

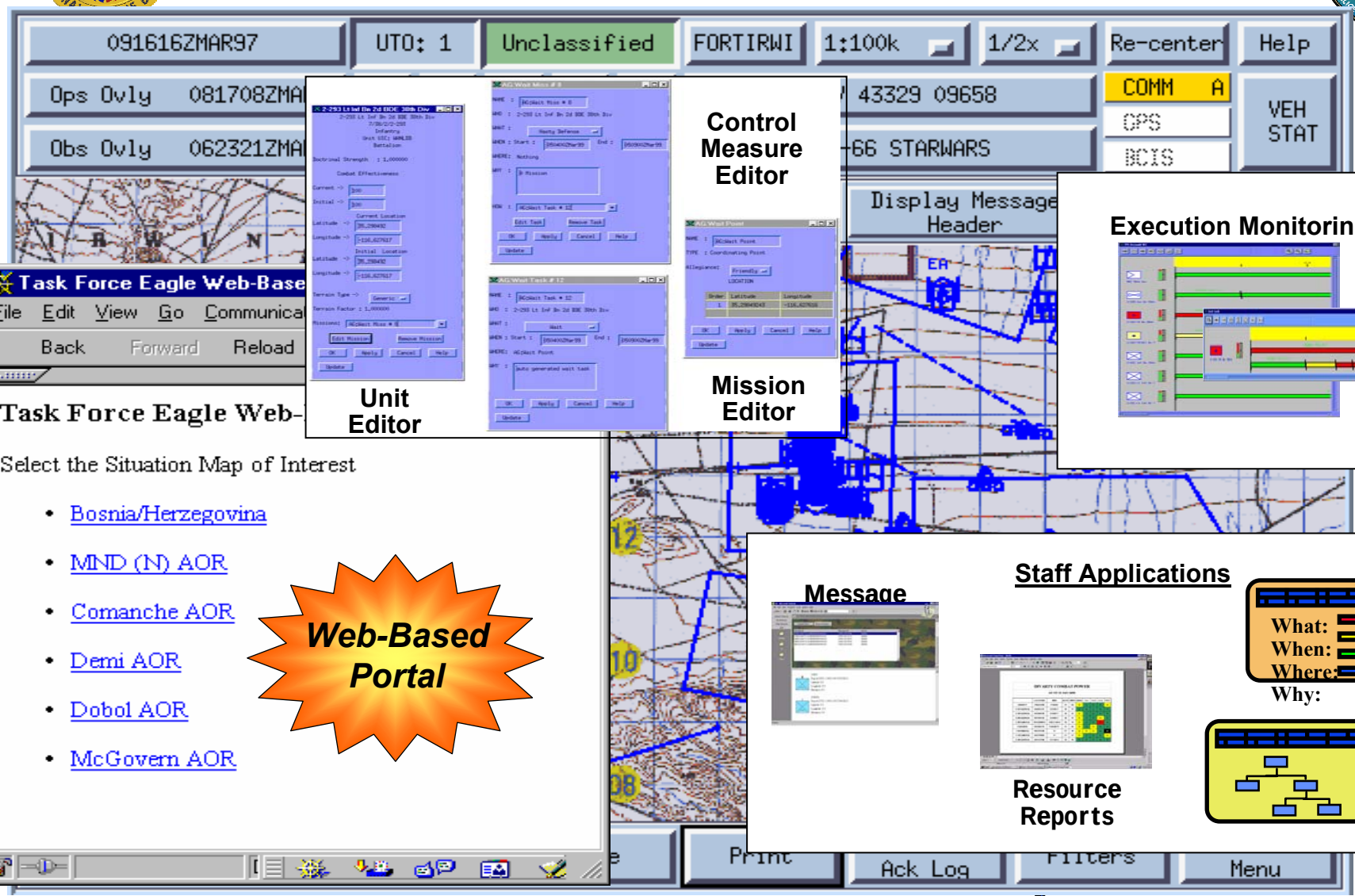


SINCE WCP Interactive OPORD Development
(Collaboration & Common Battle Command Language)

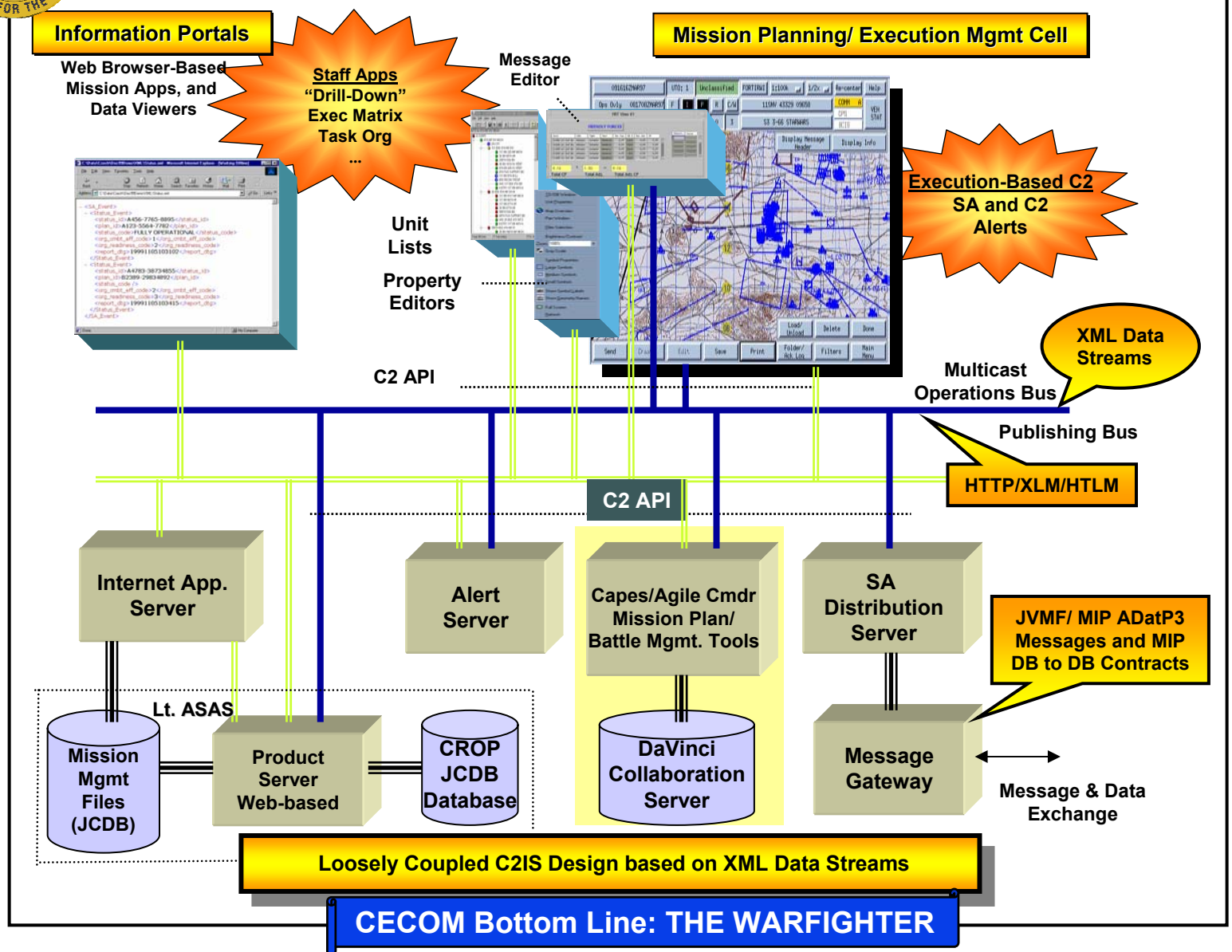
To facilitate the interactive development of a coalition OPORDs using Web-based technologies and standards we are

- **Using XML documentation specifications and constructs**
- **Creating XML document instances via core XML Specifications (Style/Schema)**
- **Parsing natural language OPORD text and graphics in terms of a *Battle Command Language* using a W6H Reference Model**
- **Formalizing a common coalition ontology that will enable common understanding of OPORD tasks, missions, concepts, etc. by coalition partners**
- **Appling this ontology to support interactive collaboration**
- **Using the planning ontology and XML constructs developed under the Agile Commander/CAPES efforts**
- **Also coordinating with SIMCI on their BML and C4ISR reference model development effort and leverage as it becomes available**

WCP Supports Real-Time Collaboration & Info Exchange between Coalition Force Planners



US Emulated Objective Force & FCS C2 Systems



Combined Arms Planning & Execution Monitoring System (CAPES)

CAPES – C2 Toolset enabling the commander and staff to rapidly and effectively plan/monitor/replan combined arms (e.g. maneuver, fires, logistics) operations

Planning

- Mission Analysis
- COA Development
- COA Analysis
- COA Comparison
- COA Approval
- Orders Generation

Military Decision Making Process

Automated Reasoning & Decision Support Tools

CAPES

Tactical Picture & Execution Alerts

Execution Monitoring

JCDB

Monitor Joint Common Database for Plan Contingencies

Visualization & Collaboration

- Map Background
- Mil Std Graphics
- COA animation

- Horizontal Plan Collaboration
- Vertical Plan Collaboration

CECOM Bottom Line: THE WARFIGHTER

FY 03 SINCE Tasks

- **Task1: Experiment 1 Program Management and Schedule Tracking**
  - Program execution management, milestone & schedule tracking, documentation
- **Task 2: SINCE C2Sim Proxy Server Development**
  - Expand capability of Feasibility Prototype to meet Experiment 1 needs
  - Multiple types of MIP C2 message, LC2IEDM DB replication data contracts, M&S HLA Object data and Plan graphics/overlay information exchanges
- **Task 3: Command & Control (C2) Planning Cell Definition and Implementation**
  - Integration of C2 systems & software to meet Experiment 1 needs
  - Expand capability of Web-based Collaboration Portal (WCP) Prototype to support Mission Planning/Mgmt. Information Exchange needs of Experiment 1
- **Task 4: Operational Working Group (OWG) Documentation Dev. Tasks**
  - Define Experiment 1 Operational scenario, functions & testing requirements
  - Develop Operational Implementation Plan and Operational Test Plan
- **Task 5: Technical Working Group (TWG) Documentation Dev. Tasks**
  - Define Technical Implementation Concept, requirements and architecture
  - Develop Technical Implementation Plan, Integration Plan and Test Plans

(Tentative SINCE Technical Experiment 1a Target Dates - Nov 2003)

(Tentative SINCE Operational Experiment 1b Target Dates - Apr 2004)

Key FY 03 SINCE Products/Effort Timelines

Documentation Products

- US/GE SINCE Project Agreement *(Signed -11/24/02)*
- Program Implementation Plan & Schedule
  (PIP approved 11/15/02, Schedule revised 4/31/03)
- Operational Implementation Plan (OIP) *(7/1/03)*
- Operational Test & Evaluation Plan (OTEP) *(9/8/03)*
- Operational Experimentation Plan (OEP) *(8/8/03)*
- Technical Implementation Plan (TIP) *(8/11/03)*
- Technical Test & Evaluation Plan (TTEP) *(10/6/03)*
- Technical Experimentation Plan (TEP) *(9/8/03)*
- Program Security Instruction *(Approved– 4/31/03)*
- Technical Experiment 1A Final Report *(12/16/03)*
- Operational Experiment 1B Final Report *(6/8/04)*

Technical & Experiment Support Activities

- C2Sim Proxy Server Implementation & Info Exchange Interoperability Testing (US)
  (Integration- 6/9-8/4/03; Testing-8/5-8/25/02)
- C2 Cells & WCP Implementation & Functional/Interoperability Testing (US)
  (Integration ; 6/9-8/28/03 Testing- 8/29-9/26/03)
- Experiment 1A Combined US/GE Technical Integrated Systems Testing *(11/10-11/13/03)*
- Experiment 1B C2 Cell & M&S Sys. Operator Training *(3/4-3/12/04)*
- Conduct of Technical Experiment 1A
  (Greding, Germany) *(11/10-11/21/03)*
- Conduct of Operational Experiment 1B
  (US- TBD maybe Trans-Atlantic) (4/19-4/29/04)
- Dignitary Briefing and Demonstration
  (4/30/04)

Summary and Conclusions

- **The goal of SINCE is to demonstrate and transition a Collaborative Suite of C2 Support Tools that:**
  - **Capable of supporting coalition force operations (across conflict spectrum)**
  - **Compliant with evolving network centric, Objective Force/FCS concepts, tactics, techniques and procedures (TTP), doctrine, architecture & Army DII-COE.**
  - **Integrate/incorporate use of real-time CROP Situation Awareness (SA) and collaboration to promote better, common understanding of an Operation's execution between coalition force partners.**
  - **Demonstrate/evaluate interface mechanisms that enable C2 Information systems to use M&S systems in support of Coalition-Force COAA and Mission Rehearsal**
- **Provide prototype, "state of the art", Web/XML based Information Portal capability enabling/ supporting exchange of real-time CROP SA, planning and battle management information with coalition Partners having nation-specific C2I systems**
- **Refine Coalition Force Operational Procedures and experience with alternate and new ways of achieving interoperability**

SINCE Project Synopsis

- **OVERALL OBJ ECTIVE:**
  - **Refine, experiment and demonstrate improved collaborative C2 Mission Planning & Mgmt Decision Support Tools tuned to support "On the Move" coalition operations.**
  - **Develop and demonstrate interoperable Web-based Coalition COP Info Exchange and Collaboration capabilities tuned to support SASO & Peace Keeping Ops.**
  - **Develop and demonstrate a Web-based, Xml-oriented, digitized OPORD/FRAGO information exchange tool supporting continuous coalition collaborative planning activities using a common Battle Management Language ontology.**
  - **Implement a reusable, flexible, cost-effective R&D network of C2I, M&S, & Decision systems designed to support Coalition Ops concept evaluation, experimentation and mission rehearsal activities.**
- **PRODUCTS: Suite of Collaborative, Web-based C2 Collaboration, Information Portal and C2Sim Proxy Server software for exchange of Coalition Common Operating Picture (CCOA) situation awareness and Demo of Common C2I & M&S systems info exchange interface for support of multi-nation experiments.**
- **OUTPUT/EXIT CRITERIA: Experiments demonstrating better, faster, more accurate Coalition Ops decision support, current is manual; goal fully automated; minimum is greater than 50% automated. Incremental ATD & PEO software drops every 18 months**

C2D PROJECT TEAM:

US PROGRAM MGR: Dr. Dirk R. Klose
PROJ ENGR: Dr.Mayk, H. Negaran, A. Chan, J. MAI, G. Kainz
M&S ENGINEER: Greg Ilaria
PLATFORM/INTEGRATION ENGR: NA
PROTOTYPING ENGR: NA
POWER ENGR: NA
FINANCIAL REP: Ms. Mary Mellone

Outside CECOM Team Members:

TRADOC:
MMBL (Ft. Knox): David Estes
BCBL (Ft. Leavenworth): Col Hiemstra
Support Contractors:
- **Gestalt Inc.(C2Sim Proxy Server Integration)**
- **LNK Corp with Austin Info Inc. (C2 COP)**
- **Mak Inc. (M&S HLA Support/Integration)**
- **Viecore Inc. (Capes & C2 System Implementation**
- **Farance Inc & I-Logic (Web Doc/UML Support)**
- **GS Research LLC(Karl Gunzelman & Langston BCBL/MMBL Support)**

Backup Slides

SINCE Program Focus and Goals

The focus of US/GE SINCE experimentation activities:

- Conduct of **Collaborative Mission Planning and Execution Management** activities as needed to support Objective Force/FCS coalition force operations at the Brigade and **Battalion** levels.
  - ⇨**Improved Information Exchange and Situation Understanding leveraging evolving solutions e.g. MIP, LC2IEDM, etc.**
  - ⇨**Streamlined Decision Making Process for Coalition OPs**
- Demonstrate **Common International Information Exchange Interface** supporting connection of C2 Information Systems (C2IS) and Modeling and Simulation (M&S) systems used in experiments
- **Integrate M&S into** the Coalition OPs **Decision Making Process**

SINCE Operational Program Goals are to:

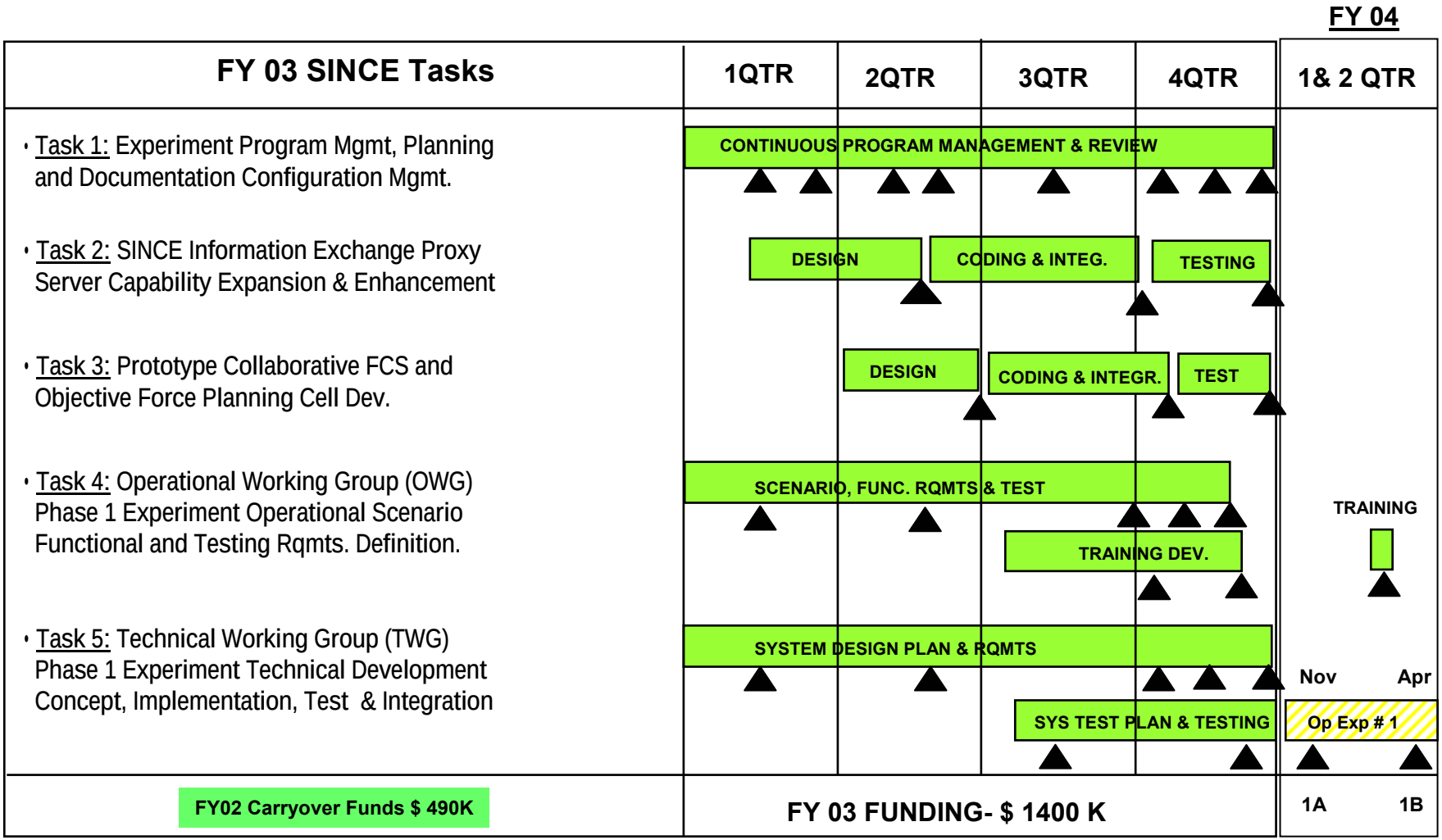
- Provide Coalition Force Commanders with improved means for
  - ⇨**Visualizing and Understanding the Coalition Battle Space**
  - ⇨**Conducting Collaborative Ops Management Activities**

Significant FY03 Accomplishments

- ***US/ GE SINCE Project Agreement***
  - Mr. Craig Hunter, Deputy Assistant Secretary of the Army for Defense Exports and Cooperation, OASA(AL&T) signed Agreement 26 Sept 02.
  - Dr. K. Schoenback, Präsident IT-Amt BWB, signed agreement on 25 Nov 02
- ***US/GE SINCE Program Security Instruction (PSI)***
  - SINCE Program Security Instruction was completed during the 28-31 Apr 03 PMG Meeting and sent out for national staffing
- ***Program and Milestone Schedule***
  - Revised Program and Milestone Schedule was approved 28-31 Apr 03 PMG Meeting
- ***SINCE C2Sim Proxy Server***
  - SINCE Experiment 1 C2Sim Proxy Server Implementation Concept approved 28-31 PMG Meeting
- **TWG & OWG *defined SINCE Experiment 1 Technical Test Bed Configuration***
  - SINCE Technical Experiment 1A Test Bed Configuration approved 28-31 PMG Meeting
- ***Operational Implementation Plan (OIP) & Scenario for Experiments 1A & 1B***
  - PMG approved current draft and directed final, completed product be delivered 31 June 03
- ***Detailed XML tagged representation and data mapping*** of MIP/LC2IEDM ADatP3 messages and the Coalition OPORD completed. M&S ***HLA FOMS mapping*** is still in progress.
- ***SINCE Web-based Doc*** went operational May 03.

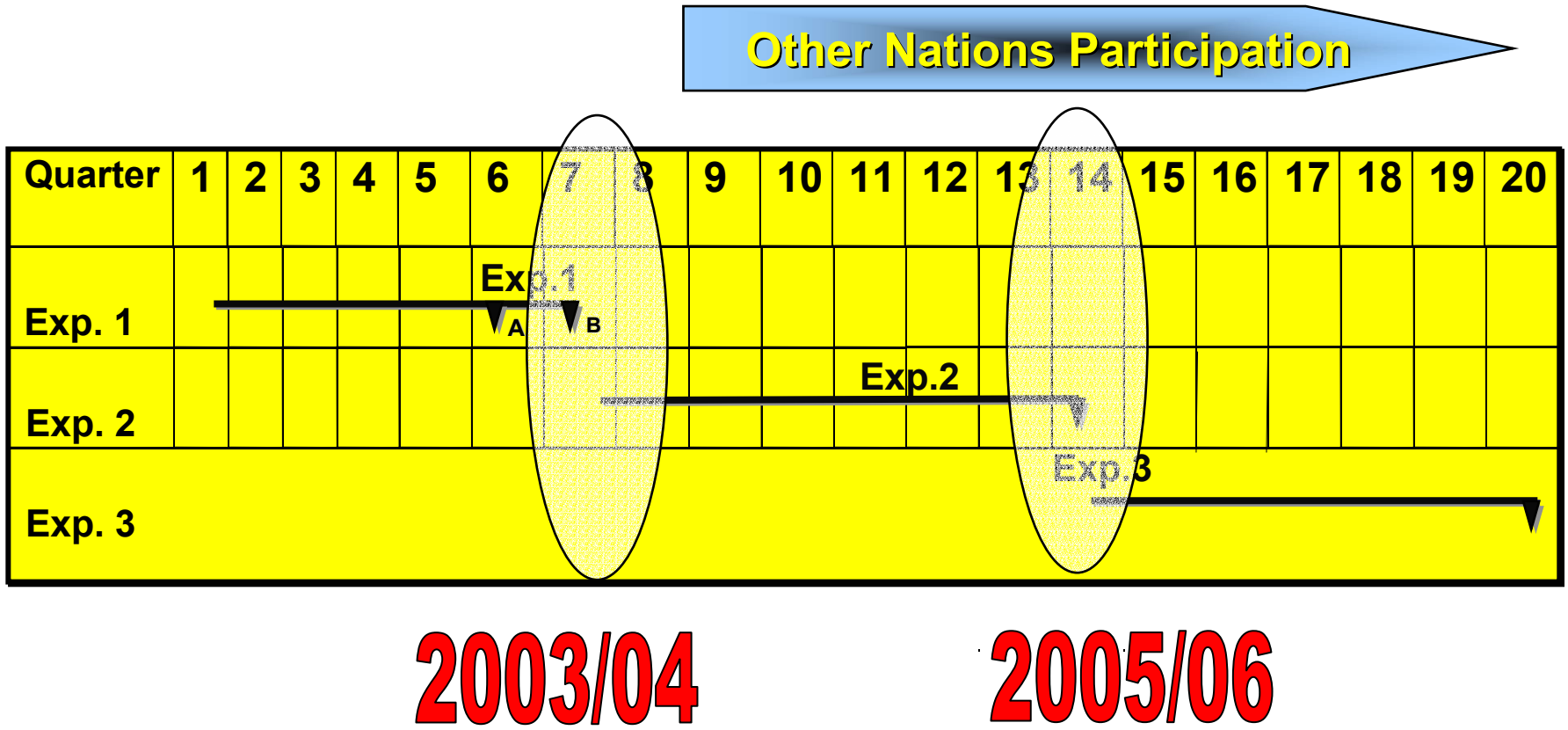
SINCE Task Execution Schedule

FY 03 SCHEDULE AND COST



CECOM Bottom Line: THE WARFIGHTER

SINCE Experiment Schedule & Perspective



CECOM Bottom Line: THE WARFIGHTER

Summary and Conclusions

- The goal of the US is to demonstrate and transition to PEO C3S, ABCS PMs, FCS and Objective Force C2I System PMs a Collaborative Suite of Mission Planning, Execution Assessment, Dynamic Re-Planning and Decision Support Tools that:
  - ⇨ Have been harmonized and validated to support coalition force operations (Both Traditional and Stability and Support Operations)
  - ⇨ Compliant with evolving network centric, Objective Force/FCS Mission Planning, Execution & Battle Management concepts, tactics, techniques and procedures (TTP), doctrine, architecture & Army DII-COE
  - ⇨ Integrate/incorporate use of real-time CROP Situation Awareness (SA) and collaboration to promote better, common understanding of an Operation's execution between coalition force partners
  - ⇨ Demonstrate/evaluate interface mechanisms enabling C2 Information systems to use M&S systems in support of COAA and Coalition Force Mission Rehearsal
  - ⇨ Specification, demonstration and evaluation of a common, bi-directional interface enabling/supporting international experimentation in collaborative. coalition force C2 Mission Planning/Battle Management CPX's
- Demonstrate of a "state of the art", Web/XML based Collaboration Portal capability enabling/ supporting exchange of real-time CROP SA information with coalition Partners having on rudimentary C2I systems
- Refine Coalition Force Operational Procedures and experience with alternate and new ways of achieving interoperability